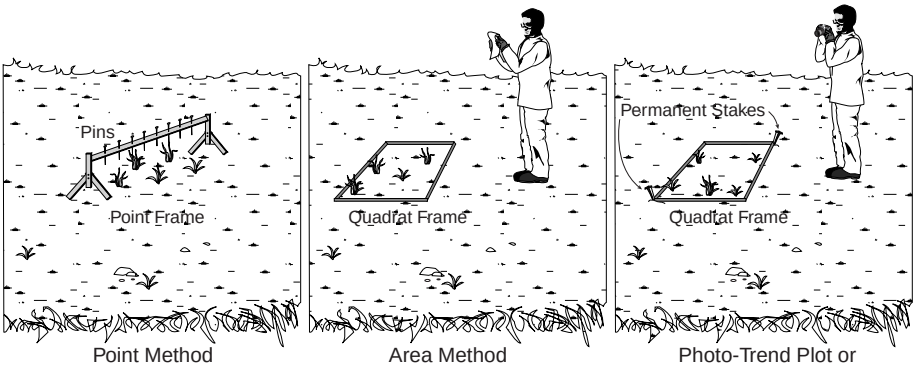

The cover, composition, and condition of tundra vegetation are measured to assess the state of the tundra before and after treatment, to monitor trends in recovery, and for comparison with adjacent non-affected areas. Long-term monitoring with photo-trend plots can document the recovery of tundra plants. Revegetation test plots can be established to determine whether plants will germinate or survive under certain circumstances and can provide important information when designing a treatment program. Identification of plants and implementing some of the monitoring techniques may require special expertise. If appropriate, consult with a plant scientist or other qualified person to develop a plan or to conduct the vegetation monitoring.

Vegetation Cover

There are two common methods to estimate vegetation cover: (1) point and (2) area methods (Bonham, 1989).

- ***Point methods*** rely on the contact of a single point, such as a pencil or a metal pin, on a plant. Either the point contacts a part of the plant or it does not. The point, or a collection of points, is used to estimate the cover in an area. Individual points are seldom used to estimate plant cover. Instead, points are collected in groups along a line or within a frame. A square-frame point method, which is popular for measuring cover of grasses and grass-like plants, uses the crosshairs of wires as guides for points. In this method, the total number of points recorded at a location divided by the number of points with vegetation "hits" represents the fraction of vegetation cover. For example, if 100 points are measured and 25 points have "hits" on plants, then the total plant cover would be 25%. Usually a number of locations are evaluated at a site and the data combined. These methods require special expertise in plant science and ecology, but point methods are the most objective way to measure cover.
- ***Area methods*** are relatively simple to implement and involve placing a quadrat (a square or circle) of known area on the ground surface and estimating the plant cover based on visual observations of the quadrat. A 20- by 50-centimeter frame is a popular quadrat size for estimating tundra vegetation cover. Usually a number of quadrats (30) are evaluated at a site to reduce the bias inherent in this method. If more than one person is estimating plant cover, the people should train together and compare estimates within the same quadrats.

Vegetation Composition

Tundra vegetation communities include a variety of vascular plants such as sedges, grasses, and other grass-like plants, forbs (broad-leaved herbs), dwarf or prostrate shrubs, mosses, liverworts, other lower plants and lichens. The diversity of plant species is a useful gauge of vegetation recovery at a site when compared to similar adjacent areas unaffected by the spill. Accurate identification of plants or lichens requires some training or special expertise in plant science. Several technical publications and flower guides can help in the identification of Alaskan tundra plants, including the following:

- Hulten, E. 1968. *Flora of Alaska and Neighboring Territories.* Stanford University Press. Stanford, CA. 100 pp. [vascular plants].
- Pratt, V.E. 1989. *Field Guide to Alaskan Wildflowers*. Alaskakrafts Publishing, Anchorage, AK. 136 pp. [vascular plants].
- Thomson, J.W. 1984. *American Arctic Lichens 1: The Macrolichens.* Columbia University Press, New York, NY. 504 pp. [lichens].
- Threlkeld, N. 1991. *Flowering Plants of the High-Arctic*. Flora Publishing, Las Cruces, NM. 37 pp. [vascular plants].
- Trelawny, J.G. *Wildflowers of the Yukon, Alaska, and Northwest Canada*. Sono Nis Press, Victoria, BC, Canada. 214 pp. [vascular plants].
- Viereck, L.A. and E.L. Little, Jr. 1986. *Alaska Trees and Shrubs*. University of Alaska Press. Fairbanks, AK. [vascular plants].
- Viereck, L.A., C.T. Dyrness, A.R. Batten, and K.J. Wenzlick. 1992. *The Alaska Vegetation Classification System.* Gen. Tech. Rep. PNW-GTR-286.U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. Portland, OR. 278 pp. [plant communities].
- Vitt, D.H., J.E. Marsh, and R.B. Bovey. 1988. *Mosses, Lichens and Ferns of Northwest North America.* Lone Pine Publishing, Edmonton, Alberta, Canada. 296 pp. [mosses and liverworts].

Condition

The condition of tundra plants growing on the site is evaluated qualitatively based on simple visual examination. Look for signs of growth, reproduction (flowers, seeds, spreading by roots) and vigor (health) using healthy vegetation not affected by the spill near the site as a reference. Signs of poor growing conditions, stress, or toxic effects may include dead plants or dead leaves, discoloration such as yellow leaves, stunted plants, lack of reproduction, and slow or no growth. Remain alert to effects of grazing, which may have removed some plant parts. Evaluation of the condition of plants does not require special expertise, although some training by experts in plant science may be useful to identify less obvious effects.

Photo-Trend Plots

Long-term monitoring with photographs of permanent plots is a popular technique for evaluating the recovery of tundra. Wooden or steel "rebar" stakes with aluminum caps can be used as markers for permanent plots. A 1-meter-square quadrat made of white PVC pipe or commercial frames is commonly used, with two stakes placed marking the opposite corners to delineate plots. Prepare a map of the plot locations so that someone else can find the plots later (Tactic AM-1). Some photo-trend plots of experimental oil spill sites on the North Slope have been documented for over 25 years, providing valuable information about the recovery of the tundra. If possible, use the same film speed and camera focal length each time a plot is documented.

Revegetation Test Plots

Before undertaking large-scale treatments such as excavation and offsite disposal (Tactic T-13), fertilizing (Tactic T-17), seeding (Tactic T-21), or transplanting (T-22), it may be desirable to determine whether seeds will germinate or transplants will survive under given conditions. Revegetation test plots can be marked and mapped using the same methods for establishing photo-trend plots, and assessed using cover, composition, and condition estimates.

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